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PROVISIONAL INTELLIGENCE REPORT

THE FIXED NITROGEN INDUSTRY IN COMMUNIST CHINA

CIA/RR PR-71
1 September 1954

CENTRAL INTELLIGENCE AGENCY

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THE FIXED NITROGEN INDUSTRY IN COMMUNIST CHINA

CIA/RR PR-71

(ORR Project 22.159)

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THE FIXED NITROGEN INDUSTRY IN CHINA*

Summary

In 1953, Communist China's consumption of chemical fixed nitrogen is estimated to have been 107,280 metric tons.** This is approximately the same amount as is used in Poland. China imported 50,900 tons, or 47 percent of total 1953 consumption, from other countries.

Agriculture consumed 94 percent of this fixed nitrogen, 100,780 tons, in the form of 475,000 tons of ammonium sulfate fertilizer. Of the remaining 6 percent, approximately 1 percent was used in military explosives and 5 percent for the production of industrial chemicals.

Domestic production of ammonium sulfate is expected to rise from 235,000 tons in 1953 to 274,000 tons in 1954, and to 313,000 tons in 1955. The amounts of chemical fertilizers used in China are so small as to have little effect on total agricultural output. The primary crop upon which chemical fertilizers have been used, however, is cotton; this development has helped to make the Chinese Communists virtually self-sufficient in that commodity. The government is using chemical fertilizers to aid collectivization of agriculture by channeling available supplies to collectives rather than to privately operated farms.

History has demonstrated a necessity for fixed nitrogen capacity in time of war. During military emergency, nitrogen is diverted from the production of nonstrategic chemical fertilizers and dyestuffs to increased production of nitric acid, for use in making explosives.

Because the fixed nitrogen capacity of Communist China is inadequate for even peacetime requirements, it is believed that Chinese intentions are to expand capacity as rapidly as possible.

* The estimates and conclusions contained in this report represent the best judgment of the responsible analyst as of 1 June 1954.
** Throughout this report tonnages are given in metric tons.

Under present conditions, however, the inadequacy of the Chinese chemical industry would force the government to depend almost entirely on foreign supply in the event of war.

I. Introduction.

A. Significance.

The fixed nitrogen industry is important to the economy of Communist China for three reasons: (1) it contributes to increasing yields of agricultural crops as a fertilizer; (2) it is essential for the production of explosives; and (3) some of its products enter into a variety of industrial uses, primarily into the chemical industry.

In bulk-tonnage use of fixed nitrogen products, the agricultural sector consumes by far the largest proportion of Chinese production. The use of chemical nitrogen fertilizer in China is so small, however, that in terms of total agricultural production its effect is not pronounced. Furthermore, in 1953 approximately two-fifths of the chemical fertilizers used were imported.

In terms of specific agricultural crops, the Chinese are emphasizing the use of chemical nitrogen fertilizer. This is particularly true in the case of cotton production, where fertilizers have materially assisted the Chinese in becoming self-sufficient.

The Chinese Communist state is actively engaged in producing military and mining explosives. While large-scale warfare by the Chinese undoubtedly would require explosives from the USSR, as were supplied during the active fighting and military buildup of North Korea, the increasing domestic production of fixed nitrogen improves the Chinese war potential.

Production of dyestuffs is probably restrained in favor of explosives manufacture -- it is possible to import dyes and utilize the domestic production of the required raw materials, including

concentrated nitric acid, an important fixed nitrogen product, for manufacturing explosives. Moreover, much of the specialized equipment used in making dyestuffs can be used in producing explosives.

B. Resources.

The fixed nitrogen industry of China depends upon three principal sources of nitrogen: nitrogen in the atmosphere and byproduct nitrogen of bituminous coal and oil shale processing. Modern technology has provided an economical method for fixing the nitrogen of the atmosphere, a system linking the production of fixed nitrogen products to an inexhaustible supply of raw material. The fixed nitrogen products derived from bituminous coal are secondary products resulting from gasification of coal, a process used to produce fuel gas and coke. Also of a secondary nature are the fixed nitrogen products resulting during retorting of oil shale for its mineral oil content.

However the fixing of nitrogen is accomplished, once it is "fixed" it enters a processing cycle which makes it available to Chinese industry and agriculture. By using techniques and equipment suitably adapted for the processing of ammonia, the initial product, nitrogen is transformed into an ammonia-water solution, liquid ammonia, nitric acid, ammonium sulfate, and/or other ammonium and nitrate salts.

In addition to the three principal sources of fixed nitrogen, there are several other sources which are not developed to a significant scale in China at the present time. The one which will require future consideration is the source of fixed nitrogen found in the production of calcium cyanamide which is obtained from calcium carbide.

C. Natural Sources of Nitrogen.

A traditional source of fixed nitrogen in China has been the production of potash salts from the processing of urine-containing soils. Such processing has never advanced beyond the cottage industry level. Other natural sources of fixed nitrogen include organic and nonorganic materials. Nitrogen fixation is accomplished by certain soil organisms, called nitrogen fixers, as those living symbiotically on roots of various leguminous plants. Most important

of the organic sources include animal manures, bean cakes, and night-soil, all of which are widely used in China as fertilizer and provide significant amounts of nitrogen for Chinese agriculture. Additional organic sources include dried blood, tankage (from garbage), sewage disposal sludge, bone meal, dried albumin, dried fish scraps, oil meal resulting from the expressing of oil from soy beans, cottonseed, and groundnuts. Small deposits of sodium nitrate similar to the large natural deposits of inorganic "Chile saltpeter" are also found in China. The working of these natural deposits is not, however, a significant factor in the supply of fixed nitrogen.

II. Production.

A. History.

Production of synthetic ammonia was undertaken in China during the thirties. In 1935 the Manchurian Chemicals Company, a Japanese firm, began operating a large plant at Kanching-tzu. 1/* Following the occupation of the mainland by the Japanese, production of ammonia expanded considerably in the occupied portions of China and Manchuria. The drive for industrialization of this portion of their empire came to fruition, in one sense, in the production of ammonia, both synthetic and byproduct.

At first the bulk of production was converted into ammonium sulfate fertilizer, reaching a peak production of 259,000 tons in 1938. (See Table 1.)** Then as the Japanese became more deeply involved in war, larger quantities were diverted to the manufacture of explosives and other related chemicals.

Following the capitulation of Japan in 1945, Soviet dismantling in Manchuria and Communist and Nationalist civil strife resulted in destruction of processing facilities and of large portions of the industries supporting the production of fixed nitrogen products. 2/ By 1950 the efforts of the Communists to restore and replace production facilities damaged or stolen during the immediate postwar period resulted in a total production of 65,000 tons of ammonium sulfate, about 25 percent of the 1938 level.

* Footnote references in arabic numerals are to sources listed in Appendix E.

** Table 1 follows on p. 5.

Table 1

Estimated Production of Ammonium Sulfate in China
1928-53 3/

Metric Tons

Year	Byproduct Sources	Synthetic Sources	Total Production	Percent Synthetic to Total
1928	11,300	0	11,300	0
1929	11,900	0	11,900	0
1930-32		No Data Available		
1933	28,900	0	28,900	0
1934	27,200	0	27,200	0
1935	39,000	118,000	157,000	75
1936	39,000	142,000	181,000	79
1937	42,000	180,000 a/	222,000	81
1938	60,000	199,000 b/	259,000	77
1939	46,000	144,000 b/	190,000	76
1940	36,000	175,000 b/	211,000	83
1941	57,000	163,000 b/	220,000	74
1942	48,000	103,000	151,000	68
1943	45,000	54,000	99,000	55
1944	29,000	78,000	107,000	55
1945-49		No Data Available		
1950	30,000 c/	35,000 c/	65,000	54
1951 d/	69,000	82,000	151,000	54
1952 e/	90,000	106,000	196,000	54
1953 f/	108,000	127,000	235,000	54

a. To the known production from synthetic sources is added 35,000 metric tons, the estimated production of the Liu-ho Yungli Chemical Works during 1937. This estimate is based on the fact that the plant started up in February 1937, and was reported operating at capacity up until seizure by the Japanese in November 1937.
b. To known production from synthetic sources is added 30,000 metric tons, the estimated annual production of the Liu-ho Works, under Japanese operation for the years 1938-41. The plant is believed to have ceased operations in 1941 for lack of coal supplies, and no subsequent production for the pre-V-J Day period is estimated. Operation by the Japanese was reported to have been at about 60 percent of capacity during 1938.

Table 1

Estimated Production of Ammonium Sulfate in China
1928-53
(Continued)

c. Byproduct and synthetic production for 1950 estimated on the basis of available data on operative plant capacity, partially supported by the ratio of synthetic production to the total estimated for 1950.
d. Production for 1951 is based on an estimated rate of increase of sulfuric acid production, a direct input item, 1951 over 1950. The percentage ratio of synthetic production to the total is estimated to be the same as 1950, supported by direct interpolation between 1953 and 1950 estimates of production.
e. Production for 1952 is based on the reported Chinese Communist plan figure of 130, with the 1951 production index being 100. The percentage ratio of synthetic production to the total is estimated the same as 1950, supported by direct interpolation between 1953 and 1950 estimates of production.
f. Production for 1953 is estimated on the basis of available data which indicate maximum utilization of plant capacity. This estimate is supported by Chinese Communist announcements of expansion programs undertaken during 1953, which are to increase the amounts of domestic fertilizer available for consumption. The percentage ratio of synthetic production to the total is based on the individual plant production estimates.

B. Recent Production.

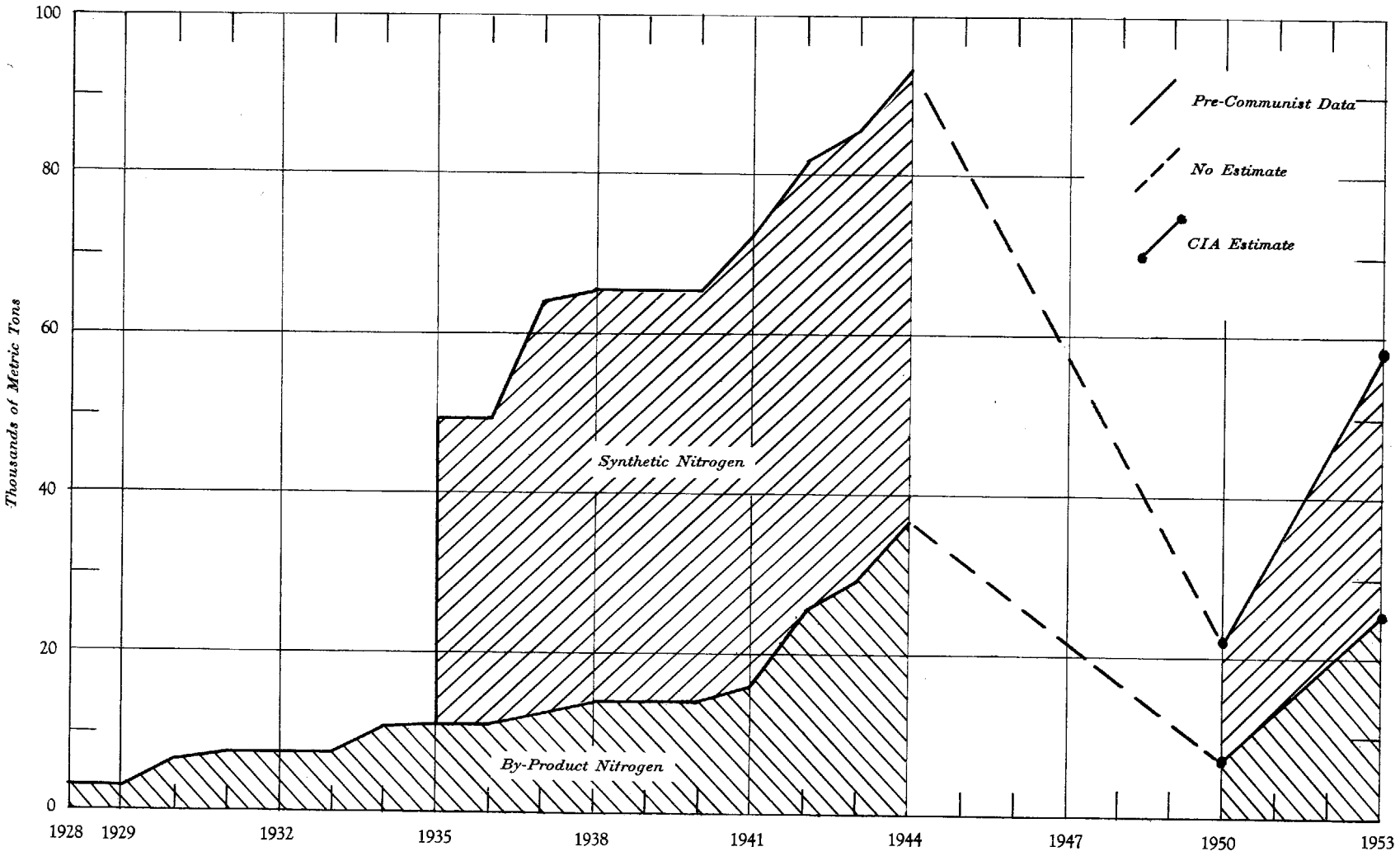
Recent efforts in the fixed nitrogen field have been intensive, since the production of fixed nitrogen at once feeds the demands of war, industrialization, and agriculture. As indicated in Table 1 and Figure 1,* these efforts resulted in a total production of 235,000 tons of ammonium sulfate in 1953, approximately 90 percent of the 1938 peak. Table 1 shows estimated production of ammonium sulfate in China, 1928-53.

* Figure 1 follows p. 6.

Figure 1

COMMUNIST CHINA

FIXED NITROGEN (N) CAPACITY 1928-1953



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C. Determining a Nitrogen Balance.

The common denominator for fixed nitrogen products, both synthetic and byproduct, is nitrogen. Amounts of fixed nitrogen products can be compared on the basis of their common denominator. This is what is generally referred to as a "nitrogen balance."

In considering the data available for obtaining a nitrogen balance of Chinese fixed nitrogen products, the first step is to reduce the established production figures for ammonium sulfate to (N).* The data presented in Table 1** have been converted to (N) and are presented in the converted form in Table 2.***

The record of Chinese plant capacity for production of fixed nitrogen is then introduced, along with estimates of maximum operable capacity for production for the years 1950 and 1953. These data are presented in Table 3**** and are shown in Figure 1.*****

Outstanding trends indicated in these data are: (1) a significant increase in capacity for fixed nitrogen production in 1935, when the first plants for production of synthetic ammonia were installed; and (2) a rapid buildup of capacity for byproduct fixed nitrogen production during the period 1940-44, when intensive efforts were made by the Japanese to build war potential by constructing metallurgical coke and shale oil plants.

In Figure 2,****** the data on byproduct ammonium sulfate production given in Table 2 have been compared with byproduct capacity indicated in Table 3. Trends indicated in this comparison are: (1) ammonium sulfate production fell off during the war years of 1941-44 against a rapid increase in capacity for byproduct production, and (2) production estimates for 1950-53 follow closely capacity interpolations between the same years.

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* This symbol designates the nitrogen content.
** P. 5, above.
*** Table 2 follows on p. 8.
**** Table 3 follows on p. 9.
***** Following p. 6, above.
****** Figure 2 follows p. 8.

Table 2

(N) Content of Ammonium Sulfate Produced in China
1928-53

Metric Tons

Year	Byproduct Sources	Synthetic Sources	Total
1928	2,400	0	2,400
1929	2,520	0	2,520
1930-32		No Data Available	
1933	6,130	0	6,130
1934	5,770	0	5,770
1935	8,300	25,000	33,300
1936	8,300	30,100	38,400
1937	8,900	38,200	47,100
1938	12,800	42,200	55,000
1939	9,700	30,600	40,300
1940	7,600	37,200	44,800
1941	12,000	34,600	46,600
1942	10,200	21,800	32,000
1943	9,500	11,500	21,000
1944	6,200	16,500	22,700
1945-49		No Data Available	
1950	6,400	7,400	13,800
1951	14,600	17,400	32,000
1952	19,100	22,500	41,600
1953	22,900	27,000	49,900

Comparison of synthetic ammonium sulfate production figures in terms of (N) with synthetic nitrogen capacity (see Figure 3)* indicates that: (1) since ammonium sulfate production drops rapidly during the war years 1940-43 against an increase in capacity, a buildup of synthetic ammonia capacity increases war potential; and (2) production estimates for the years 1950-53 parallel the estimated buildup of operable capacity to 1953.

* Figure 3 follows p. 8.

Figure 2

COMMUNIST CHINA

BY-PRODUCT NITROGEN CAPACITY COMPARED WITH AMMONIUM SULFATE PRODUCTION

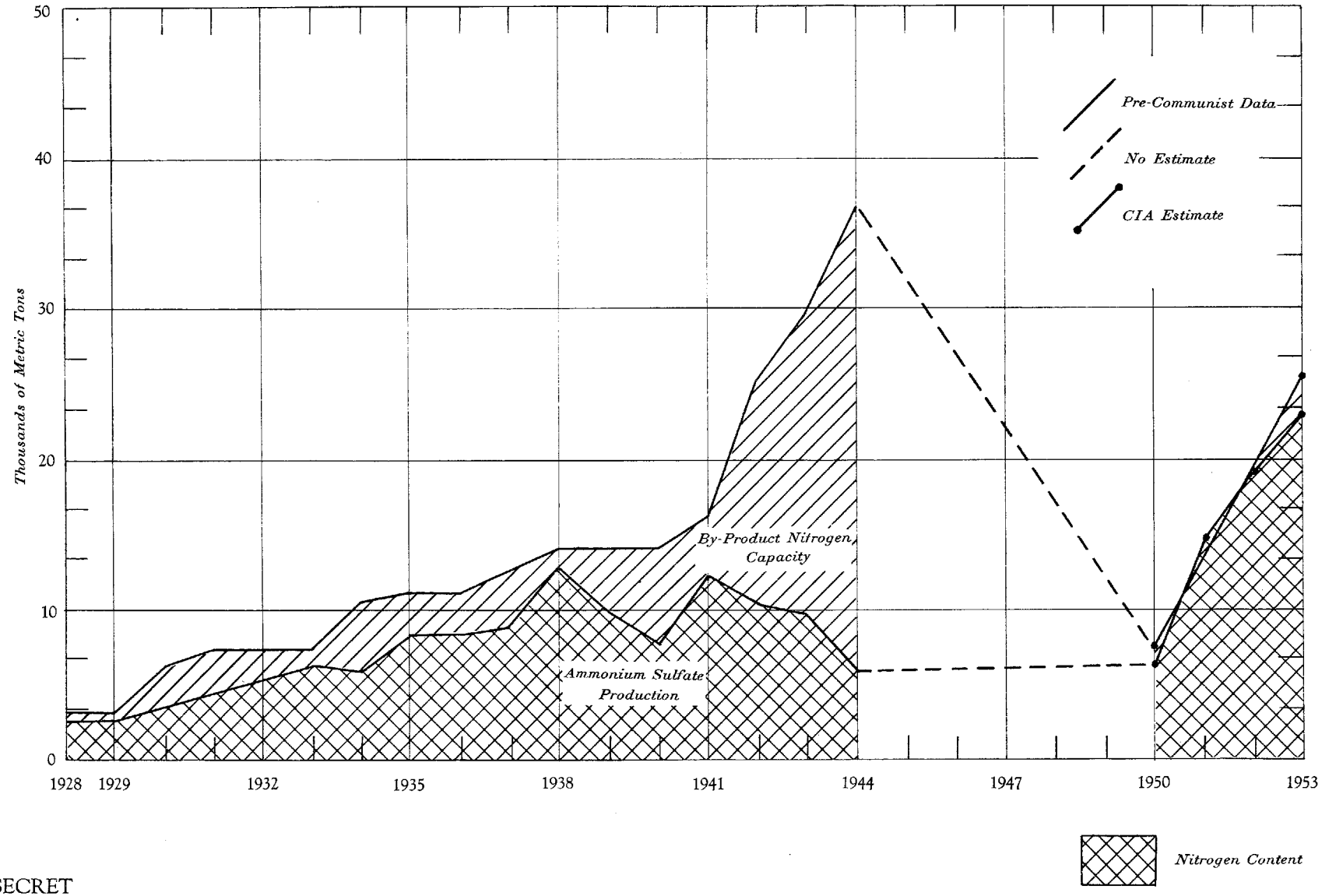

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Figure 3

COMMUNIST CHINA

SYNTHETIC NITROGEN CAPACITY COMPARED WITH AMMONIUM SULFATE PRODUCTION

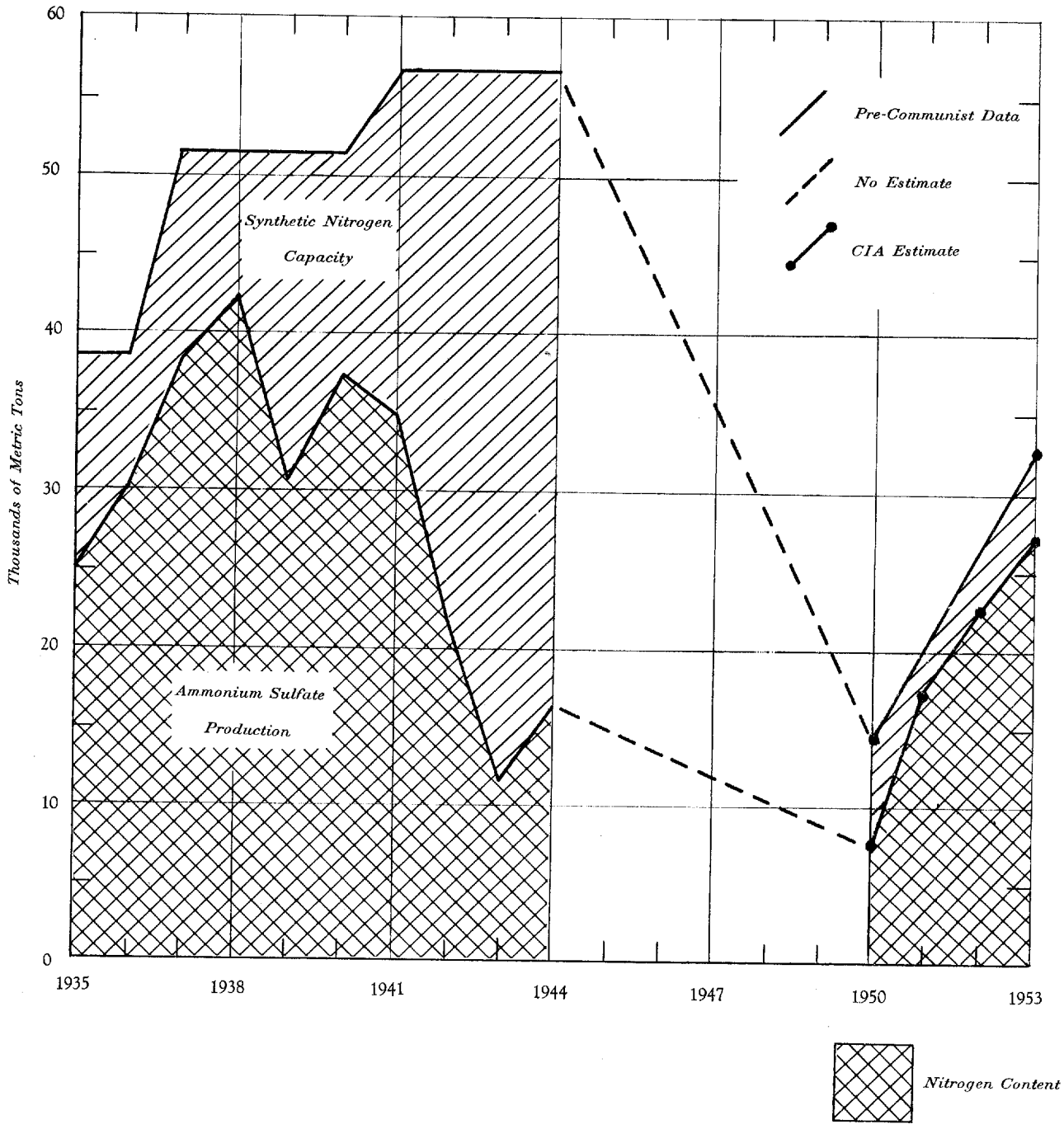

Table 3

Estimated Fixed Nitrogen (N) Capacity in China 4/
1928-53

Metric Tons

Year	Byproduct Sources	Synthetic Sources	Total
1928	3,100	0	3,100
1929	3,100	0	3,100
1930	6,300	0	6,300
1931	7,200	0	7,200
1932	7,200	0	7,200
1933	7,200	0	7,200
1934	10,400	0	10,400
1935	11,000	38,400	49,400
1936	11,000	38,400	49,400
1937	12,400	51,400	63,800
1938	14,000	51,400	65,400
1939	14,000	51,400	65,400
1940	14,000	51,400	65,400
1941	15,900	56,400	72,300
1942	25,400	56,400	81,800
1943	29,400	56,400	85,800
1944	36,700	56,400	93,100
1945-49		No Data Available	
1950	7,300	14,400	21,700
1951		No Data Available	
1952		No Data Available	
1953	25,500	32,400	57,900

There are not enough data on the production of the important fixed nitrogen products other than ammonium sulfate to allow direct examination. However, this production contributes directly to Chinese military strength in the form of such products as ammonium nitrate and nitric acid. Fortunately, there is a historical reference to productive capacity for these products in Chinese synthetic ammonia installations, and some recent Communist government production indexes are available to permit a partial analysis and inclusion

in a nitrogen balance. The Chinese Communist State Statistical Bureau in Peiping has announced nitric acid and ammonium nitrate planning and accomplishment in terms of production indexes, with 1951 as the base year. 5/ Table 4 presents these indexes of production in Communist China.*

Maximum capacity for production of these products at synthetic ammonia plants believed to have been operable in 1953 is estimated as follows: (1) nitric acid, 20,100 tons per year, or 4,500 tons (N) per year; and (2) ammonium nitrate, 11,400 tons per year, or 2,000 tons (N)** per year. Operation of these facilities for the production of nitric acid and ammonium nitrate is estimated at 100 percent of capacity during 1953, on the basis of Chinese announcements on planned or actual expansion of facilities during 1953. 6/ It is believed that announcement of expansion assumes maximum operation of existing facilities.

Applying the Chinese Communist production factors to the estimated production capacity for nitric acid and ammonium nitrate, production is indicated in comparison with estimated production of ammonium sulfate in Table 5.***

In Figure 4,**** allocation of synthetic ammonia production (as nitrogen) for the products listed above is shown graphically for the years 1951-1953. It will be noted that production estimates as total nitrogen are 3.4 percent above the capacity estimate for 1953. It is believed that this variance is within a reasonable limit of error.

III. Consumption.

Because agricultural production has always been the foundation of China's economy, it is apparent that the bulk of fixed nitrogen consumption has been chiefly in the agricultural sector. Chinese

* Table 4 follows on p. 11.

** The fixed nitrogen portion indicated represents only the ammonium part of ammonium nitrate. The fixed nitrogen portion of the nitrate is included in the nitric acid estimate.

*** Table 5 follows on p. 11.

**** Figure 4 follows p. 10.

Figure 4

COMMUNIST CHINA

SYNTHETIC AMMONIA - PRODUCTION ALLOCATION

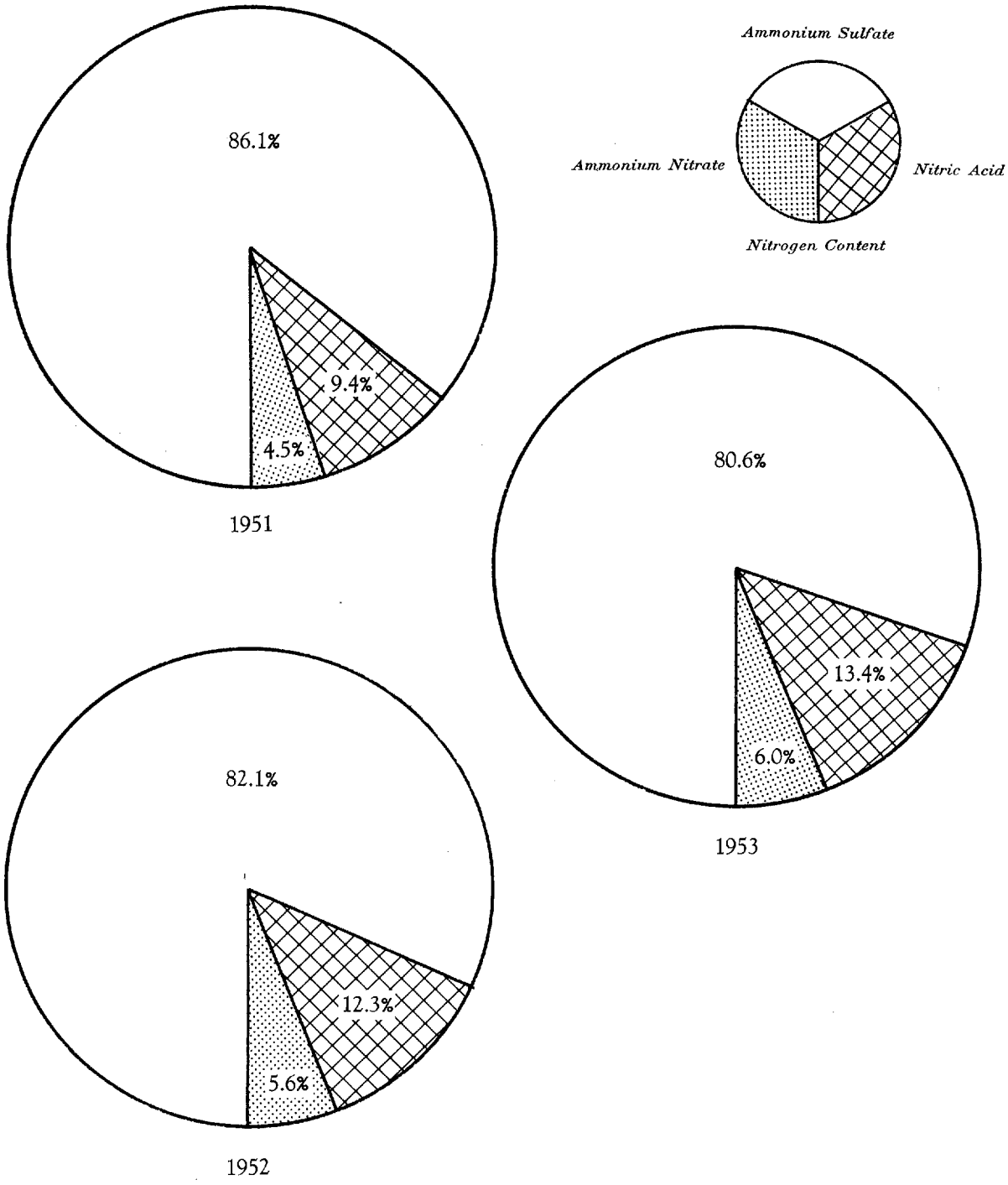

Table 4

Indexes of Production in Communist China
1951-53

Metric Tons

Fixed Nitrogen Production	1951		1952		1953	
	Plan	Accomp.	Plan	Accomp.	Plan	Accomp.
Nitric Acid	N.A.	100	164	176	236	N.A.
Ammonium Nitrate	N.A.	100	108	169	223	N.A.

Table 5

Estimated Allocation of Production of Synthetic Ammonia
in Communist China
1951-53

Metric Tons

	1951		1952		1953	
	Product	Equivalent (N)	Product	Equivalent (N)	Product	Equivalent (N)
Nitric Acid	8,500	1,900	15,000	3,360	20,100	4,500
Ammonium Nitrate	5,100	900	8,650	1,520	11,400	2,000
Ammonium Sulfate	82,000	17,400	106,000	22,500	127,000	27,000
Totals	95,600	20,200	129,650	27,380	158,500	33,500

consumption of nitrogen during 1953 amounted to an estimated 107,280 tons. A breakdown of these requirements follows:

	(N) Content
Agriculture (As ammonium sulfate fertilizer)	100,780 tons*
Military explosives (As propellants and high explosives)	1,790
Industrial chemicals	
Nitric acid	2,710
Ammonium nitrate	2,000
Total	107,280

Using the data presented in Table 2,** in combination with the net imports*** into China of ammonium sulfate as nitrogen, consumption of ammonium sulfate fertilizer as nitrogen may be estimated. This combination of data is presented in Table 6.**** The estimated consumption of ammonium sulfate as nitrogen is compared with total Chinese capacity for production of fixed nitrogen in Figure 5.*****

It is clear from an analysis of the Chinese Communist press that requirements of nitrogen as chemical fertilizers greatly exceed the current supply, including imports. Crop yields per acre could be significantly increased if adequate supplies of chemical fertilizers were available. Long-range plans are to increase the supply of chemical nitrogen fertilizer. Since an increase of agricultural production remains the principal source of investment funds for Chinese Communist industrialization goals, a high priority may be assigned to such a program. Moreover, Communist China is not

* This quantity includes 50,880 tons of nitrogen imported as ammonium sulfate fertilizer.

** P. 8, above.

*** Net imports adjusted during the years 1928-44 for Manchurian and pre-World War II Chinese trade.

**** Table 6 follows on p. 13.

***** Figure 5 follows p. 12.

Figure 5

COMMUNIST CHINA

FIXED NITROGEN CAPACITY COMPARED WITH AMMONIUM SULFATE CONSUMPTION

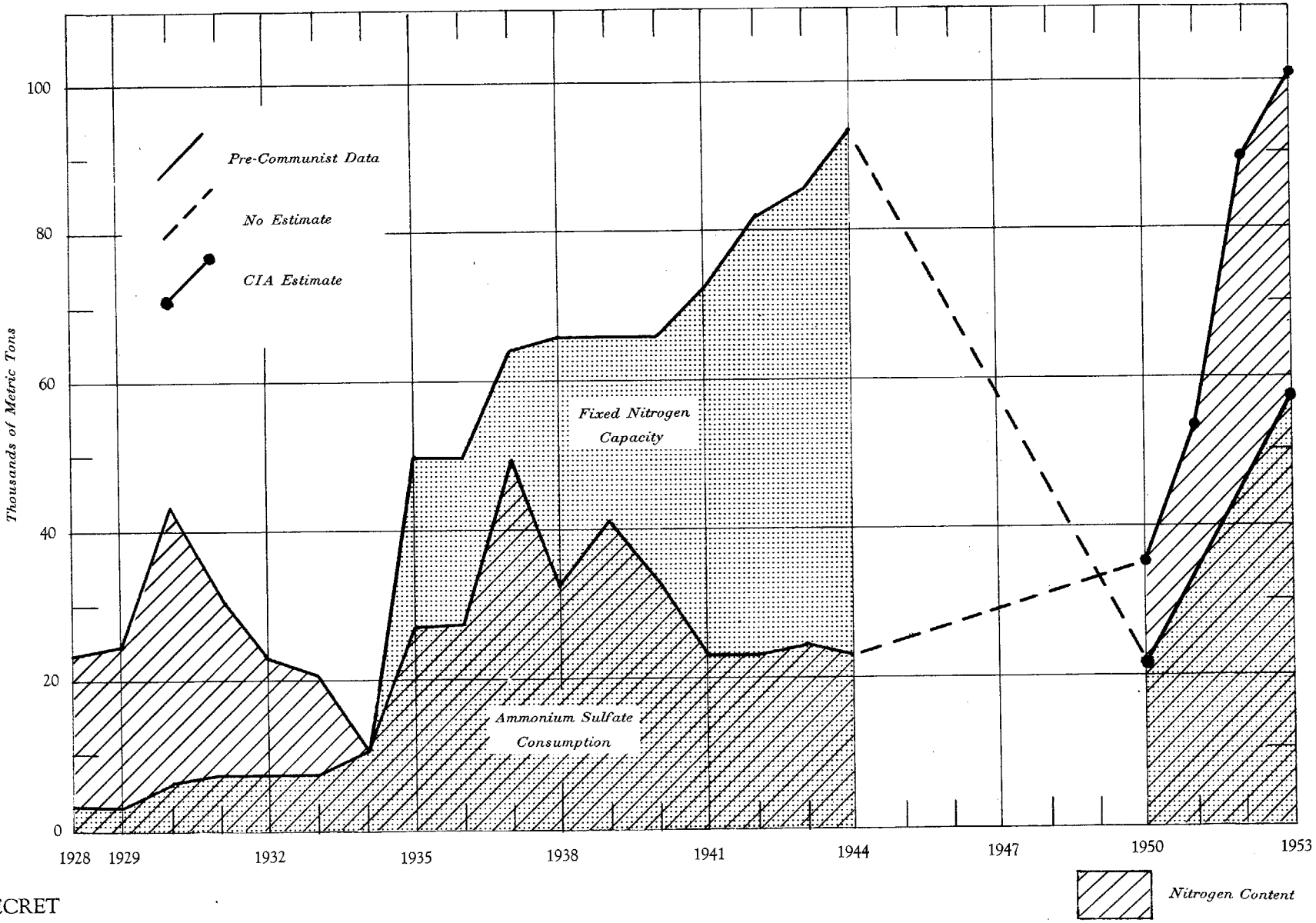

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Table 6

Estimated Consumption of Ammonium Sulfate Fertilizer in China
1928-53 7/

Nitrogen Equivalent in Metric Tons

Year	Ammonium Sulfate Production (N)	Ammonium Sulfate (N) Net International Trade (+) Imports (-) Exports	Total (N) Estimated Consumption
1928	2,400	(+) 20,940	23,340
1929	2,520	(+) 21,990	24,510
1930	3,500 a/	(+) 39,870	43,370
1931	4,400 a/	(+) 27,250	31,650
1932	5,300 a/	(+) 17,910	23,210
1933	6,130	(+) 14,330	20,460
1934	5,770	(+) 4,630	10,400
1935	33,300	(-) 6,430	26,870
1936	38,400	(-) 11,110	27,290
1937	47,100	(+) 1,880	48,980
1938	55,000	(-) 22,430	32,570
1939	40,300	(+) 470	40,770
1940	44,800	(-) 11,634	33,170
1941	46,600	(-) 23,050	23,550
1942	32,000	(-) 8,500	23,550
1943	21,000	(+) 3,240	24,240
1944	22,700	0	22,700
1945-1949		No Data Available	
1950	13,800	(+) 21,200	35,000
1951	32,000	(+) 21,200	53,200
1952	41,600	(+) 47,700	89,300
1953	49,900	(+) 50,880	100,780

a. Obtained by interpolation from Figure 2.

self-sufficient with respect to the production of military explosives, which require nitrogen, particularly smokeless powder and bursting charges. The agricultural, ammunition, and industrial requirements for nitrogen are such that they will be unable to fulfill them through the period of the First Five Year Plan, ending in 1957.

IV. Transportation Problems.

A. Statement of the Problems.

Transportation is an essential element in the study of fixed nitrogen in China because of the physical bulk of the raw materials and of the manufactured products. In obtaining byproduct nitrogen from coal, a very small percentage of the total coal bulk is yielded in fixed nitrogen. This same condition holds in the recovery of fixed nitrogen in the retorting of oil shale. Fixed nitrogen obtained from synthetic ammonia processes also requires bulky amounts of coal and coke. And finally, the chief product in terms of bulk is ammonium sulfate fertilizer. Distribution to individual agricultural systems, ranging from the peasant to the collective farm, creates a particularly difficult transportation problem.

Aside from a consideration of the transportation problem in terms of bulk, other problems arise from the special nature of certain fixed nitrogen products. Precautions must be taken in handling of nitric acid, a highly corrosive liquid, and also in transporting ammonium nitrate, a highly explosive material. Special shipping containers are required to transport such products as liquid ammonia, which is gaseous at atmospheric pressures and must be compressed and confined to be handled as a liquid.

B. Chemical Fertilizer.

Tonnages of chemical fertilizer handled by the Chinese Communist transportation system amount to some one-half million tons per year. Tradition, climate, and usage have determined that the bulk of fixed nitrogen fertilizer is ammonium sulfate. Approximately 50 percent of the ammonium sulfate consumed in China is imported from other countries, which involves at least 25 ocean-going ships capable of handling 10,000 tons each when fully loaded. Distribution within China involves about 25,000 Chinese railway

freight cars, each containing 20 tons. Because railway transportation is not sufficiently available to agricultural areas, a large part of the ammonium sulfate is distributed by river junk, motor truck, cart, hand truck, and by manual labor.

The domestic manufacture of ammonium sulfate involves the metallurgical coke, fuel gas, shale oil, sulfuric acid, and synthetic ammonia manufacturing plants of China. These plants require coal, oil shale, coke, pyrites, and sulfuric acid.

In this industry, supply of the large tonnages of basic raw materials is provided by modern transportation nets. These nets include the present-day Chinese railways, canals, river and coastal shipping systems, and motor truck transport. An estimate of the quantities of materials involved in the manufacture of ammonium sulfate by various methods is shown in Table 7.*

C. Other Fixed Nitrogen Products.

Little is known of the specific transportation problems arising in the actual transfer of other fixed nitrogen products such as nitric acid, ammonium nitrate explosives, or liquid ammonia. However, these materials, while of strategic importance, do not bulk as large as the movement of fertilizer nitrogen. In addition, many of the transportation problems involved in movement of materials mentioned above consist of inter-plant transfers, using primarily the modern transportation nets of the industrial sector. (Example: the Ch'ang-ch-un rail net in the industrial Northeast.)

V. Expansion Plans and Probabilities.

A. Synthetic Ammonia.

Chinese intentions are to expand existing synthetic ammonia plants. It is believed that they will also construct new plants. At least one site for the construction of a new plant has been located.

Production estimates for 1953 have been based on maximum utilization of plant capacity. These estimates have been supported

* Table 7 follows on p. 16.

Table 7

Estimated Material Requirements in Production
of Ammonium Sulfate at Selected Plants in Communist China

	Metric Tons
1. Coal byproduct (example: An-shan Iron and Steel Combine)	
a. Production-ammonium sulfate	21,800
b. Coal required	1,900,000
c. Iron pyrites required	15,100
d. Sulfuric acid required	16,200
2. Oil Shale byproduct (example: Fu-shun No. 1 Plant)	
a. Production-ammonium sulfate	75,000
b. Oil shale required	7,500,000
c. Iron pyrites required	51,900
d. Sulfuric acid required	55,600
3. Synthetic ammonia plant (example: Liu-ho Yungli Works)	
a. Production-ammonium sulfate	61,300
b. Coal required	50,800
c. Coke required	34,800
d. Sulfuric acid required	43,500
e. Iron pyrites required	46,000

by information which indicates expansion activities under way at both the Dairen Chemical Works and at the Liu-ho Yungli Chemical Works. At the Dairen Works expansion plans, apparently begun in April 1953, were reported in progress in late 1953 and are expected to require a minimum of 3 years. 8/ Expansion of the Liu-ho Yungli Chemical Works was announced as completed in November 1953. 9/

Prior to the collapse of the Nationalist Government on the Chinese mainland, the Liu-ho Yungli Chemical Company had started construction of a synthetic ammonia plant at Wu-t'ung-ch'iao, in Szechwan Province, near the wartime provisional capital of Ch'ung-ch'ing. 10/ This plant contained enough equipment to warrant completion of the

project, and it is believed that Chinese efforts will be directed toward completion. In view of this construction activity, capacity for producing synthetic ammonia as nitrogen for 1954 is estimated at 37,000 tons (N), and for 1955 at 46,000 tons (N). These are compared with production estimates for nitric acid, ammonium nitrate, and ammonium sulfate -- all as nitrogen -- and the predicted allocation of production of synthetic ammonia in Communist China is given in Table 8.

Table 8

Predicted Allocation of Production of Synthetic Ammonia in Communist China 1954-55

Metric Tons

	1954		1955	
	Product	Equivalent (N)	Product	Equivalent (N)
Nitric Acid	24,800	5,500	29,300	6,500
Ammonium Nitrate	13,100	2,300	15,400	2,700
Ammonium Sulfate	149,000	31,500	169,000	35,900
Total	186,900	39,300	213,700	45,100

The above estimates are compared graphically in Figure 6.* It will be noted that capacity and production estimates vary as follows: (1) production estimates, total nitrogen, are 6.2 percent higher than the capacity estimate for 1954; and (2) the capacity estimate is 5.1 percent higher than production estimates for 1955. It is believed that this variance is within a reasonable limit of error.

* Figure 6 follows p. 18.

B. Byproduct Nitrogen.

Capacity for production of byproduct nitrogen is expanding -- additional byproduct coking and oil shale plants are undergoing construction at existing plant sites, and at least one major byproduct coking plant is reported under construction at a new site.

Capacity estimates for 1953 have been based on a consideration of this expansion of Chinese byproduct plants. Expansion activities have been reported at the Fu-shun Shale Oil Plant 11/ and at the An-shan Iron and Steel Plant during 1953. 12/ Completion of the An-shan expansion is indicated to be in 1954, 13/ but it is believed that the Fu-shun plant will not be fully expanded until 1955. Further expansion of the T'ai-yüan byproduct coking plant was announced as completed in 1953. 14/ Plans for expansion of byproduct coking plants have been reported since 1950 at Kung-yüan 15/ and Peiping. 16/ Construction of a plant at Ch'i-lin, a new site for byproduct coking, began in 1951. Completion of this plant is to be in 1954. 17/ On the basis of reported expansion in byproduct nitrogen capacity, predicted capacities for production of byproduct nitrogen are: 1954, 29,700 metric tons (N); and 1955, 38,000 metric tons (N).

C. Comparison of Nitrogen Capacity and Production.

In Figure 7* these capacity estimates have been combined with synthetic nitrogen estimates, and with earlier capacity data from Table 3,** to show a comparison with total nitrogen production as obtained from data in Table 2*** and Table 5**** and projection of byproduct nitrogen production data shown in Chart 2.***** Total capacity and production data show relatively close agreement except for 1955, when the predicted rapid increase in byproduct nitrogen plant capacity results in capacity rising above projected production.

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* Figure 7 follows p. 18.
** P. 9, above.
*** P. 8, above.
**** P. 11, above.
***** Following p. 8, above.

Figure 6

COMMUNIST CHINA

SYNTHETIC AMMONIA ESTIMATED ALLOCATION

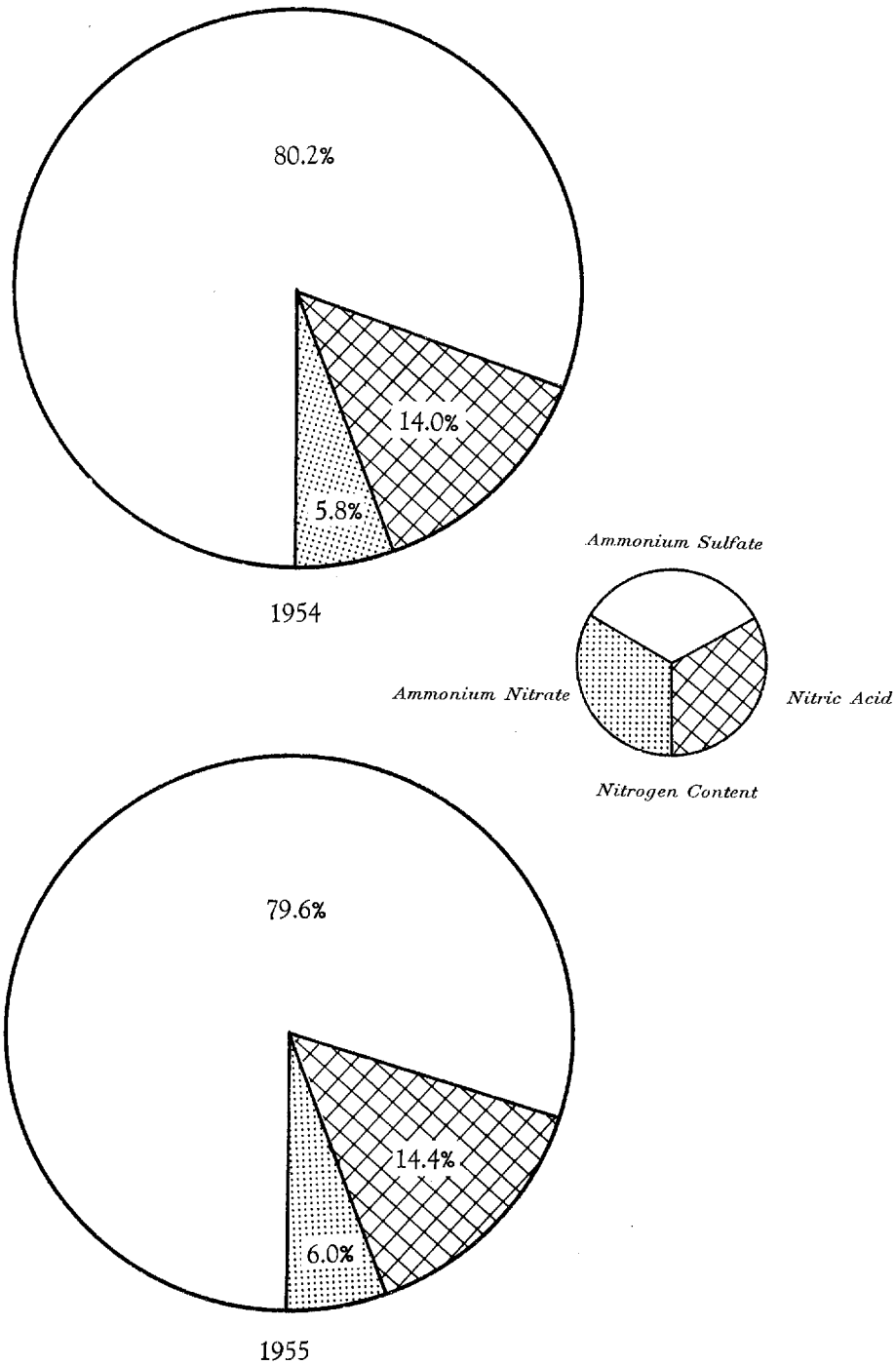
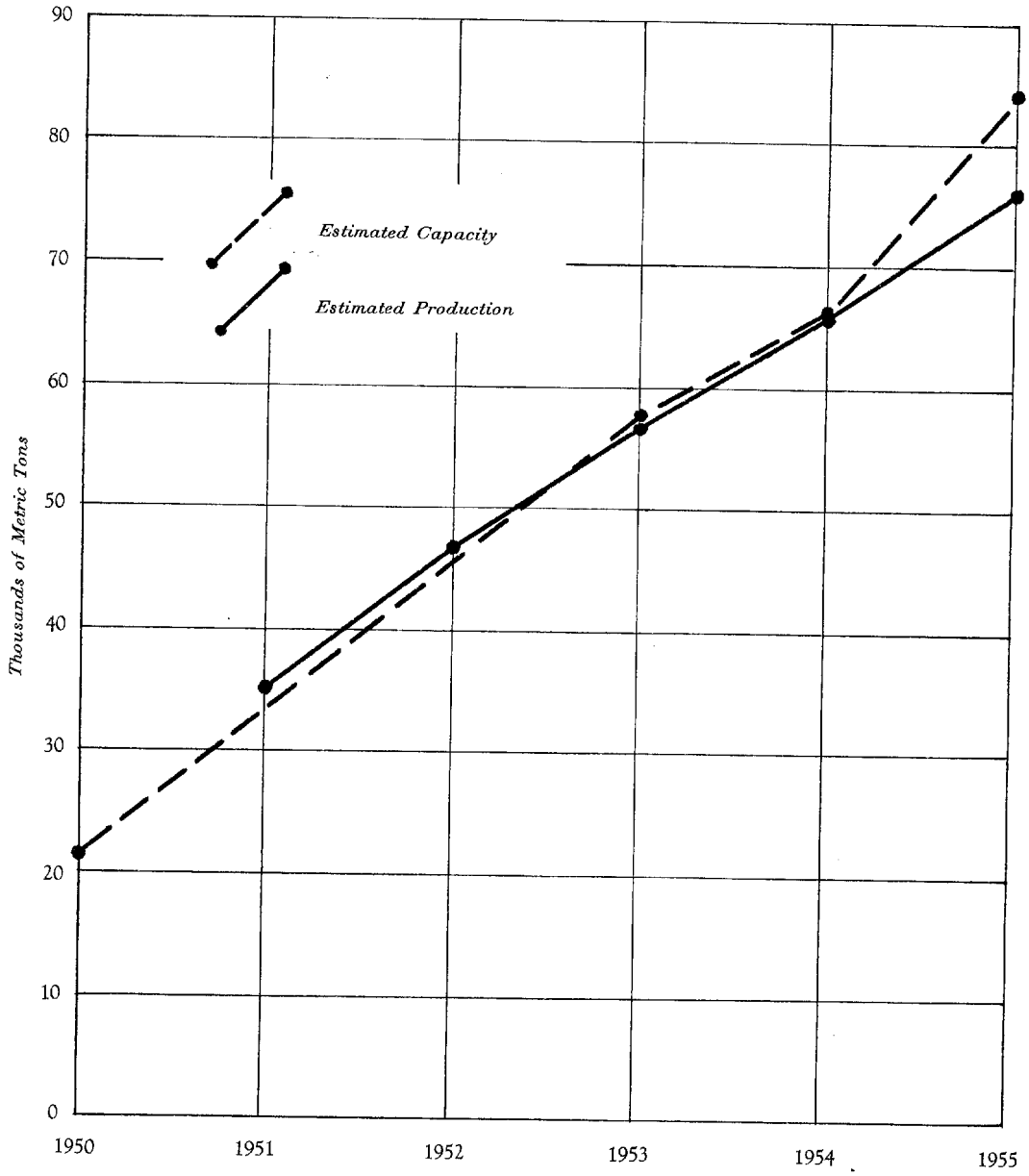


Figure 7

COMMUNIST CHINA

FIXED NITROGEN CAPACITY ESTIMATES COMPARED WITH PRODUCTION ESTIMATES



VI. Capabilities, Vulnerabilities, and Intentions.

A. Capabilities.

The fixed nitrogen industry of China is incapable of meeting domestic demands. To meet the demand for chemical nitrogen fertilizer, about one-half of the supply is imported from abroad. The Chinese Communist government is instrumental in controlling the allocation of chemical nitrogen fertilizer to various segments of agriculture. Since importation is directly controlled by the state, it is probable that the government is encouraging use of chemical nitrogen fertilizer above the capacity of the domestic industry to produce it.

While the amounts of ammonium nitrate and nitric acid are considered inadequate for domestic requirements, it is believed that they are being used in increasing amounts in the production of explosives. This trend is predicted as continuing, with fairly constant allocation of some 6 percent of the synthetic ammonia production into ammonium nitrate. Nitric acid allocation is predicted as rising from 9.4 percent in 1951 to 14.4 percent in 1955, indicating an apparently increasing demand by industry for nitric acid.

B. Vulnerabilities.

The most obvious vulnerability of the Chinese fixed nitrogen industry is its dependence upon an external supply of approximately one-half of the fixed nitrogen consumed. This dependence upon foreign sources of supply indicates inadequacy of technical equipment and/or raw materials and personnel for production of sufficient domestic fixed nitrogen.

External supply of fixed nitrogen has taken a number of forms: (1) supply of "nonstrategic"* ammonium sulfate fertilizer from Western countries, carried by Western shipping 18/; (2) supply of "strategic"** ammonium nitrate from USSR and European Satellites

* "Nonstrategic" means types of products which are destined for civilian consumption.

** "Strategic" means types of products having an actual or potential use as war material.

using Communist transportation 19/; (3) supply of nonstrategic dyestuffs from both Western and Communist countries 20/; (4) supply of strategic chemical processing equipment from USSR and European Satellites 21/; and (5) supply of technical manpower from USSR and European Satellites. 22/

Within the Chinese fixed nitrogen industry, the byproduct division has been receiving substantial amounts of production equipment, apparently because of the importance of metallurgical coke and shale oil production to the industrial economy of the country. The synthetic ammonia division of the domestic fixed nitrogen industry, on the other hand, apparently has not received any new equipment beyond requirements for restoring existing plant capacity to top efficiency. This is believed to indicate that all objectives of Chinese Communist industrialization cannot be met simultaneously.

C. Intentions.

The fixed nitrogen industry of Communist China is an indicator of intentions only to the extent that a marked shift in the use pattern from agricultural and normal industrial applications to the expanded manufacture of explosives might indicate preparation for military activity. At the present time, there is no apparent shift of that nature.

APPENDIX A

IMPORTS OF AMMONIUM SULFATE

Growth of imports into China, as indicated in Table 9, demonstrate the increasing demand for ammonium sulfate fertilizer.

Table 9

Imports of Ammonium Sulfate into China 23/
(Prewar boundaries except as noted)
1924-53

Metric Tons

Year	Amount	Year	Amount
1924	17,000	1939	122,200
1925	23,800	1940	26,400
1926	49,800	1941	10,500
1927	55,300	1942	9,900
1928	105,100	1943	15,400
1929	112,300	1944	N.A.
1930	189,500	1945	N.A.
1931	139,700	1946	50,500
1932	112,800	1947	87,600
1933	101,200	1948	20,000 a/
1934	49,900	1949	N.A.
1935	68,600	1950	100,000 a/ b/
1936	124,000	1951	100,000 a/ b/
1937	163,400	1952	225,000 a/ b/
1938	106,400	1953	240,000 a/ b/

a. Estimated.
b. Present area of Communist China.

APPENDIX B

FIXED NITROGEN PLANTS IN COMMUNIST CHINA

I. Plants on Which There Is Reliable Information.

A. Dairen Chemical Plant. 24/

1. Location: Kan-ching-tzu
2. Coordinates: Kwantung, 49°42' N - 119°41' E
3. Started Operations: 1935
4. Raw Material Sources: Synthetic Ammonia:
   Nitrogen: Air liquefaction
   Hydrogen: Coke oven-water gas
   Byproduct Ammonia: Coal
5. Processes: Synthetic Ammonia: Uhde Method
   Byproduct Ammonia: Otto Byproduct Coking Method
6. Equipment: Synthetic Ammonia: 2 Uhde Synthesis Units
   Byproduct Ammonia: 20 Otto Byproduct Ovens
7. Products: Ammonia
   Ammonium sulfate
   Nitric acid (50 percent)
   Nitric acid (98 percent)
   Ammonium nitrate
   Sodium nitrate
8. Capacities:

Ammonia	60 metric tons per day (rated capacity)
Ammonium sulfate	200
Nitric acid (50 percent)	5
Nitric acid (98 percent)	40
Ammonium nitrate	20
Sodium nitrate	0.1

9. Fixed Nitrogen Capacity Estimates:

Period	Metric Tons (N)
1928-1934	0
1935-1940	37,000 synthetic 550 byproduct
1941-1944	55,000 synthetic 700 byproduct
1945-1949	N.A.
1950	0
1951-1952	N.A.
1953	18,000 synthetic 310 byproduct

10. Comments: Three Uhde synthetic units were looted by the Soviets. A construction program, reportedly undertaken in April 1953, is estimated to take three years to complete. The plant was not producing byproduct or synthetic ammonia in 1949. It has operated, in part, as a chemical plant in support of explosives production since 1949.

B. Yung Li Chemical Works.

1. Location: Liu-ho 25/
2. Coordinates: Kiangsu, 32°20' N - 118°51' E
3. Started Operating: 1937
4. Raw Material Sources: Synthetic Ammonia
   Nitrogen: Air-producer gas
   Hydrogen: Coke-water gas
5. Processes: Synthetic Ammonia: American (Nitrogen Engineering Corporation) Method
6. Equipment: Synthetic Ammonia: 1 N.E.C. Synthesis Unit
7. Products: Ammonia
   Ammonium sulfate
   Nitric acid (63 percent)
   Nitric acid (98 percent)
   Ammonium nitrate

8. Capacities:

Ammonia	45 metric tons per day (rated capacity)
Ammonium sulfate	135
Nitric acid (63 percent)	10
Nitric acid (98 percent)	10
Ammonium nitrate	10

9. Fixed Nitrogen Capacity Estimates:

Period	Metric Tons (N)
1928-1934	0
1935-1944	13,000 synthetic
1945-1949	N.A.
1950-1953	13,000 synthetic

10. Comments: Expansion of the synthetic ammonia plant was announced as completed in November 1953. Its pre-expansion capacity is estimated at 4,167 tons per month in June 1953. Its post-expansion capacity is estimated as 5,250 tons per month in August 1953 and 6,100 tons per month in December 1953.

C. Tien-Li Nitrogen Plant.

1. Location: Shanghai 26/
2. Coordinates: Kiangsu, 31°14' N - 121°28' E
3. Started Operating: 1935
4. Raw Material Sources: Synthetic Ammonia:
   Nitrogen: Air-hydrogen combustion
   Hydrogen: Electrolysis of water
5. Processes: Synthetic Ammonia: American (Nitrogen Engineering Corporation) Method
6. Equipment: Synthetic Ammonia: 1 N.E.C. Synthesis Unit
7. Products: Ammonia
   Nitric acid (63 percent)
   Nitric acid (98 percent)
   Ammonium nitrate

8. Capacities: Ammonia — 4 metric tons per day (rated capacity)
   Nitric acid (63 percent) — 12
   Nitric acid (98 percent) — 7.5
   Ammonium nitrate — 2.5
9. Fixed Nitrogen Capacity Estimates:

Period	Metric Tons (N)
1928-1934	0
1935-1944	1,400 synthetic
1945-1949	N.A.
1950-1953	1,400 synthetic

D. Fu-shun Mining Bureau, West Shale Oil Refinery.

1. Location: Fu-shun 27/
2. Coordinates: Liaotung, 41°52' N - 123°53' E
3. Started Operating: 1930
4. Raw Material Source: Byproduct Ammonia: Oil Shale
5. Processes: Retorting of oil shale
6. Equipment: 100 metric ton retorts: 80 (capacity 150,000 tons crude oil per year)
   200 metric ton retorts: 60 (capacity 225,000 tons crude oil per year)
7. Products: Ammonium sulfate
8. Fixed Nitrogen Capacity Estimates:

Period	Metric Tons (N)
1928-1929	0
1930-1933	3,200 byproduct
1934-1941	6,400 byproduct
1942-1944	15,900 byproduct
1945-1949	N.A.
1940	4,250 byproduct
1951-1952	N.A.
1953	15,900 byproduct

9. Comments: The plant was reported in two-thirds operation in 1950. From July to December 1952 a production of 185,000 metric tons crude shale oil was reported.

E. Fu-shun Mining Bureau, East Shale Oil Refinery.

1. Location: Fu-shun 28/
2. Coordinates: Liaotung, 41°52' N - 135°35' E
3. Started Operating: 1944
4. Raw Material Source: Byproduct Ammonia: Oil Shale
5. Process: Retorting of oil shale
6. Equipment: 150 metric ton retorts: 60 (capacity 170,000 tons crude oil per year)
7. Product: Ammonium sulfate
8. Fixed Nitrogen Capacity Estimates:

Period	Metric Tons (N)
1928-1943	0
1944	7,200 byproduct
1945-1949	N.A.
1950-1953	0

9. Comments: This plant ceased operations in 1945, but was reported under reconstruction in 1953.

F. Fu-shun Coke Plant.

1. Location: Fu-shun 29/
2. Coordinates: Liaotung, 41°52' N - 123°53' E
3. Started Operating: 1915
4. Raw Material Source: Byproduct Ammonia: Coal
5. Process: Koppers Byproduct Coking Method
6. Equipment: 30 Koppers Byproduct Ovens (capacity 136 metric tons coke per day)
7. Products: Ammonium sulfate

8. Fixed Nitrogen Capacity Estimates:

Period	Metric Tons (N)
1928-1944	160 byproduct
1945-1949	N.A.
1950	0
1951-1952	N.A.
1953	160

9. Comments: The coke ovens were reported as inoperative in 1947-1948. The gas plant was reported in operation in 1953.

G. An-shan Iron and Steel Works.

1. Location: An-shan 30/
2. Coordinates: Liaotung, 41°07' N - 122°57' E
3. Started Operating: 1920
4. Raw Material Source: Byproduct Ammonia
5. Process: Koppers and Otto Byproduct Coking Methods
6. Equipment: 432 Otto and 240 Koppers Byproduct Ovens
7. Products: Ammonium sulfate
8. Fixed Nitrogen Capacity Estimates:

Period	Metric Tons (N)
1928-1930	0
1930	1,300 byproduct
1931-1936	2,200 byproduct
1937	3,140 byproduct
1938-1942	4,750 byproduct
1943-1944	8,760 byproduct
1945-1949	N.A.
1950	1,090 byproduct
1951-1952	N.A.
1953	4,520 byproduct

9. Comment: First production under Communist government was reported in June 1949. The rebuilding of inoperative batteries has been reported in progress since June 1952.

H. Pen-ch'i Coal and Iron Works. 31/

1. Location: Pen-ch'i
2. Coordinates: Liaotung, 41°20' N - 123°45' E
3. Started Operating: 1927
4. Raw Material Source: Byproduct Ammonia: Coal
5. Process: Kuroda (?) Byproduct Coking Method
6. Equipment: 98 Kuroda (?) Byproduct Ovens (capacity 700 tons coke per day)
7. Products: Ammonium sulfate
8. Capacity: Ammonium sulfate - 2,600 tons per year
9. Fixed Nitrogen Capacity Estimates:

Period	Metric Tons (N)
1928-1944	860 byproduct
1945-1949	N.A.
1950-1953	860 byproduct

10. Comments: The plant was reported to be operating in the fall of 1951 at 700 tons coke per day.

I. Pen-ch'i Coal and Iron Works. 32/

1. Location: Kung-yüan
2. Coordinates: Liaotung, 41°18' N - 123°45' E
3. Started Operations: 1941
4. Raw Material Source: Byproduct Ammonia: Coal
5. Process: Otto Byproduct Coking Method
6. Equipment: 120 Otto Byproduct Ovens (capacity 1,400 tons per day)
7. Products: Ammonium sulfate
8. Capacity: Ammonium sulfate - 10,000 tons per year
9. Fixed Nitrogen Capacity Estimates:

Period	Metric Tons (N)
1928-1936	0
1937-1944	1,720 byproduct
1945-1949	N.A.
1950	0
1951-1952	N.A.
1953	1,720 byproduct

10. Comments: Operation of 40 coke ovens was reported in the fall of 1951, as well as the ammonium sulfate plant. Extensive removals by Soviets were reported after V-J Day.

J. Kirin Chemical Works. 33/

1. Location: Chi-lin
2. Coordinates: Kirin, 43°51' N - 126°33' E
3. Started Operating: 1942
4. Raw Material Source: Byproduct Ammonia: Coal
5. Process: Otto Byproduct Coking Method
6. Equipment: 38 Otto Byproduct Ovens (estimated capacity 960 tons coke per day)
7. Products: Ammonia liquor
8. Capacity: Ammonia liquor - 10 tons per day of 25 percent NH_3 liquor
9. Fixed Nitrogen Capacity Estimates:

Period	Metric Tons (N)
1928-1953	0

10. Comments: One battery of byproduct coke ovens was reported to be operating in 1953. Reconstruction, begun in 1951, is to be completed in 1954.

K. Shih-ching-shan Iron and Steel Works. 34/

1. Location: Peiping
2. Coordinates: Hopeh, 39°56' N - 116°24' E
3. Started Operating: 1938
4. Raw Material Source: Byproduct Ammonia: Coal
5. Process: Semet-Solvay, Mitsui (?), and Kuroda Byproduct Coking Methods
6. Equipment: 100 Semet-Solvay Byproduct Ovens (capacity 400 metric tons coke per day)
   35 Mitsui (?)
   65 Kuroda

7. Fixed Nitrogen Capacity Estimates:

Period	Metric Tons (N)
1928-1937	0
1938-1944	120 byproduct
1945-1949	N.A.
1950	240 byproduct
1951-1952	N.A.
1953	480 byproduct

8. Comments: In 1949, 50 Semet-Solvay coke ovens were reported in operation. The 1950 plans called for rebuilding batteries Nos. 2 and 3. The production goal was announced as 180,000 metric tons of coke per year. Mitsui and Kuroda ovens were still under construction at end of World War II.

L. Tai-yüan Iron and Steel Works. 35/

1. Location: T'ai-yüan
2. Coordinates: Shansi, 37°52' N - 112°33' E
3. Started Operations: 1937
4. Raw Material Source: Byproduct Ammonia: Coal
5. Process: Byproduct coking method (unknown)
6. Equipment: 36 Byproduct ovens (original equipment) (capacity 240 tons coke per day)
   30 Byproduct ovens (reported completed September 1952)
7. Products: Ammonia
   Ammonium sulfate
8. Fixed Nitrogen Capacity Estimates:

Period	Metric Tons (N)
1928-1936	0
1937-1944	290 byproduct
1945-1949	N.A.
1950-1952	290 byproduct
1953	580 byproduct

M. Shanghai Gas Company. 36/

1. Location: Shanghai
2. Coordinates: Kiangsu, 31°14' N - 121°28' E
3. Started Operating: 1876
4. Raw Material Source: Byproduct Ammonia: Coal
5. Process: Gasification of coal in retorts with recovery of byproducts
6. Equipment: 30 vertical retorts (capacity 113,500 cubic meters per day)
7. Products: Ammonia liquor
8. Fixed Nitrogen Capacity Estimates:

Period	Metric Tons (N)
1928-1944	260 byproduct
1945-1949	N.A.
1950	130 byproduct
1951-1952	N.A.
1953	260 byproduct

9. Comments: The plant was taken over by the Communist government in November 1952.

N. Wu-sung Gas Works. 37/

1. Location: Wu-sung
2. Coordinates: Kiangsu, 31°23' N - 121°29' E
3. Started Operating: 1937
4. Raw Material Source: Byproduct Ammonia: Coal
5. Process: Gasification of coal in retorts with recovery of byproducts
6. Equipment: N.A. (capacity 28,400 cubic meters per day)
7. Fixed Nitrogen Capacity Estimates:

Period	Metric Tons (N)
1928-1936	0
1937-1944	66 byproduct
1945-1949	N.A.
1950	33 byproduct
1951-1952	N.A.
1953	66

O. Shen-yang Gas Works. 38/

1. Location: Shen-yang
2. Coordinates: Liaotung, 41°48' N - 123°27' E
3. Started Operating: 1913
4. Raw Material Source: Byproduct Ammonia: Coal
5. Process: Gasification of coal in retorts with recovery of byproducts
6. Equipment: 32 horizontal bench retorts (70,000 cubic meters per day capacity)
7. Products: Ammonium sulfate
8. Fixed Nitrogen Capacity Estimates:

Period	Metric Tons (N)
1928-1944	160 byproduct
1945-1949	N.A.
1950	80 byproduct
1951-1952	N.A.
1953	160 byproduct

9. Comments: The plant was reported in operation in 1947 at 20 percent of capacity. It was also reported in operation in 1953.

P. Shih-chia-chuang Smelter. 39/

1. Location: Shih-men
2. Coordinates: Hopeh, 38°03' N - 114°29' E
3. Started Operating: 1925
4. Raw Material Source: Byproduct Ammonia: Coal
5. Process: Otto and Hinselmann Byproduct Coking Methods
6. Equipment: 20 Otto Byproduct Ovens (original installation) (3 metric tons coal per 24 hours)
   10 Hinselmann Byproduct Ovens (installed in 1930) (9 metric tons coal per 30 hours)
7. Products: Ammonia liquor

8. Fixed Nitrogen Capacity Estimates:

Period	Metric Tons (N)
1938-1930	51 byproduct
1931-1944	113 byproduct
1945-1949	N.A.
1950-1953	113 byproduct

Q. Dairen Coke and Gas Company. 40/

1. Location: Ta-lien
2. Coordinates: Kwantung, 38°55' N - 121°39' E
3. Started Operating: 1913
4. Raw Material Source: Byproduct Ammonia: Coal
5. Process: Gasification of coal in retorts with recovery of byproducts (planned capacity 23,000 tons coke)
6. Products: Ammonium sulfate
7. Fixed Nitrogen Capacity Estimates:

Period	Metric Tons (N)
1928-1944	80 byproduct
1945-1949	N.A.
1950-1953	80 byproduct

8. Comments: Plans called for operation of the plant in 1949. It was reported in operation in 1953.

R. Ch'ang-ch'un Gas Works. 41/

1. Location: Ch'ang-ch'un
2. Coordinates: Kirin, 43°52' N - 125°21' E
3. Started Operating: 1925
4. Raw Material Source: Byproduct Ammonia: Coal
5. Process: Gasification of coal in retorts with recovery of byproducts
6. Equipment: 306 retorts (capacity 16.5 million cubic meters per year)
7. Products: Ammonia
   Ammonium sulfate

8. Fixed Nitrogen Capacity Estimates:

Period	Metric Tons (N)
1928-1944	102 byproduct
1945-1949	N.A.
1950	0
1951-1952	N.A.
1953	102 byproduct

9. Comments: The plant reported in operation in 1953.

S. An-tung Gas Works. 42/

1. Location: An-tung
2. Coordinates: Liaotung, 40°08' N - 124°24' E
3. Raw Material Source: Byproduct Ammonia: Coal
4. Process: Gasification of coal in retorts with recovery of byproducts
5. Equipment: 10 horizontal bench retorts (20,000 cubic meters per day)
6. Fixed Nitrogen Capacity Estimates:

Period	Metric Tons (N)
1928-1944	46 byproduct
1945-1949	N.A.
1950	0
1951-1952	N.A.
1953	46 byproduct

T. Plant Name: N.A.

1. Location: Wu-t'ung-ch'iao 43/
2. Coordinates: Szechwan, 29°21' N - 103°51' E
3. Started Operating: 1943
4. Raw Material Source: Byproduct Ammonia: Coal
5. Process: Byproduct coking method (unknown) (capacity 50 tons coal per day)
6. Products: Ammonium sulfate

7. Fixed Nitrogen Capacity Estimates:

Period	Metric Tons (N)
1928-1942	0
1943-1944	11 byproduct
1945-1949	N.A.
1950-1953	43 byproduct

U. Plant Name: N.A.

1. Location: Ch'ung-ch'ing 44/
2. Coordinates: Szechwan, 29°34' N - 106°35' E
3. Started Operating: 1944
4. Raw Material Source: Byproduct Ammonia: Coal
5. Process: Byproduct coking method (unknown)
6. Equipment: 5 Byproduct Ovens (capacity 60 tons coal per day)
7. Fixed Nitrogen Capacity Estimates:

Period	Metric Tons (N)
1928-1943	0
1944	13 byproduct
1945-1949	N.A.
1950-1953	52 byproduct

V. Chin-hsien Gas Works. 45/

1. Location: Chin-hsien
2. Coordinates: Liaosi, 39°06' N - 121°43' E
3. Raw Material Source: Byproduct Ammonia: Coal
4. Process: Gasification of coal in retorts with recovery of byproducts
5. Equipment: 10 bench retorts (capacity 10,000 cubic meters per day)

6. Fixed Nitrogen Capacity Estimates:

Period	Metric Tons (N)
1928-1944	23 byproduct
1945-1949	N.A.
1950	0
1951-1952	N.A.
1953	23 byproduct

7. Comments: The plant was reported as being inoperative in 1947 but operating in 1953.

W. Harbin Gas Works. 46/

1. Location: Harbin
2. Coordinates: Sungkiang, 45°45' N - 126°39' E
3. Raw Material Source: Byproduct Ammonia: Coal
4. Process: Gasification of coal in retorts with recovery of byproducts
5. Equipment: 5 bench retorts (capacity 5,000 cubic meters per day)
6. Fixed Nitrogen Capacity Estimates:

Period	Metric Tons (N)
1928-1944	13 byproduct
1945-1949	N.A.
1950-1953	13 byproduct

7. Comments: The plant reportedly resumed operations in July 1948.

II. Plants on Which There Is Insufficient Information.

A. Liao-yang Explosives Factory. 47/

1. Location: Liao-yang
2. Coordinates: Liaotung, 41°17' N - 123°11' E
3. Raw Material Source: Liquid Ammonia: Dairen Chemical Plant
4. Process: Catalytic oxidation of ammonia to produce nitric acid

5. Products: Nitric acid (50 percent)
Nitric acid (98 percent)

6. Comments: Three catalytic converters for oxidizing ammonia to produce nitric acid were dismantled during Soviet occupation. No further information is available.

B. T'ai-yüan Number 1 Powder Plant. 48/

1. Location: T'ai-yüan
2. Coordinates: Shansi, 37°52' N - 112°33' E
3. Started Operating: 1934
4. Raw Material Source: Saltpeter (Potassium nitrate: Natural)
5. Process: Acidification of saltpeter with sulfuric acid to produce nitric acid
6. Products: Nitric acid (50 percent)
Nitric acid (98 percent)
Ammonium nitrate
7. Comments: Reported undergoing expansion in June 1953.

C. Po-shan Chemical Works. 49/

1. Location: Po-shan
2. Coordinates: Shantung, 36°29' N - 117°50' E
3. Products: Nitric acid

D. Plant Name: N.A. 50/

1. Location: Chu-chou
2. Coordinates: Hunan, 27°50' N - 113°09' E
3. Started Operations: 1953 (?)
4. Products: Ammonium sulfate
5. Comments: An ammonium sulfate plant was reported as included in a construction project under way in 1953.

E. Central and South Plant No. 884. 51/

1. Location: Liu-chou
2. Coordinates: Kwangsi, 24°19' N - 109°24' E
3. Products: Nitric acid

F. Nan-ning Sulfuric Acid Plant. 52/

1. Location: Nan-ning
2. Coordinates: Kwangsi, 22°49' N - 108°19' E
3. Started Operating: 1952
4. Products: Nitric acid

G. Yungsheng Chemical Works. 53/

1. Location: Heng-yang
2. Coordinates: Hunan, 26°54' N - 112°36' E
3. Products: Nitric acid

APPENDIX C

METHODOLOGY

1. General.

Inasmuch as no Chinese statistical data other than the figures for ammonium sulfate can be fully tabulated for the World War II and immediately preceding periods, Japanese production statistics for the 10 years prior to 1945 have been introduced.

The comparative relationship of the production of ammonium sulfate in China and Japan is expressed in Table 10.* It is believed that this relationship offers a clue as to the effect of war on the total production of fixed nitrogen in China. This comparison is considered valid because the bulk of fixed nitrogen produced in China during the 10-year period originated in the Japanese-controlled segment of the Chinese mainland, and reacted to the same influences as the homeland production.

The relationship of the indexes of the production of ammonium sulfate in China and Japan, shown in Table 10, below, are more sharply brought out in Figure 8.** In the attempt to supplement home production of ammonium sulfate with that of China, the rate of increased production in China exceeded that of Japan until 1940. By 1941, probably because of better control of the home industries than on the Chinese mainland, the rate of production in Japan exceeded that of China and then fell off until the close of the war, but with a less rapid decline.

Based on the reliability of a direct relationship of Chinese ammonium sulfate production indexes to Japanese figures for the 10-year period under consideration, as shown above, additional Japanese indexes may be employed to indicate by analogy to Japanese performance a possible qualitative trend of the production of fixed nitrogen from byproduct and synthetic sources in China. These data are given in Table 11.***

* Table 10 follows on p. 42.
** Figure 8 follows p. 42.
*** Table 11 follows on p. 43.

Table 10

Indexes of Chinese and Japanese Production
of Ammonium Sulfate
1934-45

1934-36 = 100

Year	Chinese	Japanese 54/
1934	22.3	74.9
1935	129.0	92.8
1936	148.7	132.3
1937	182.4	140.8
1938	212.8	167.6
1939	156.1	152.5
1940	173.3	167.7
1941	180.7	187.7
1942	124.0	173.3
1943	81.3	146.1
1944	87.9	107.9
1945	N.A.	36.5

The Japanese relationship of ammonium sulfate to dyestuffs, nitric acid, and explosives, as graphically expressed in Figure 9,* shows the following trends:

a. Production of all four of these basic products, which require significant amounts of fixed nitrogen, trends upward from the base period, as the Japanese ammonia industry was expanded, until 1938.

b. Explosives and ammonium sulfate production decreased in 1939, as increasing production of dyestuffs required increasing amounts of nitric acid.

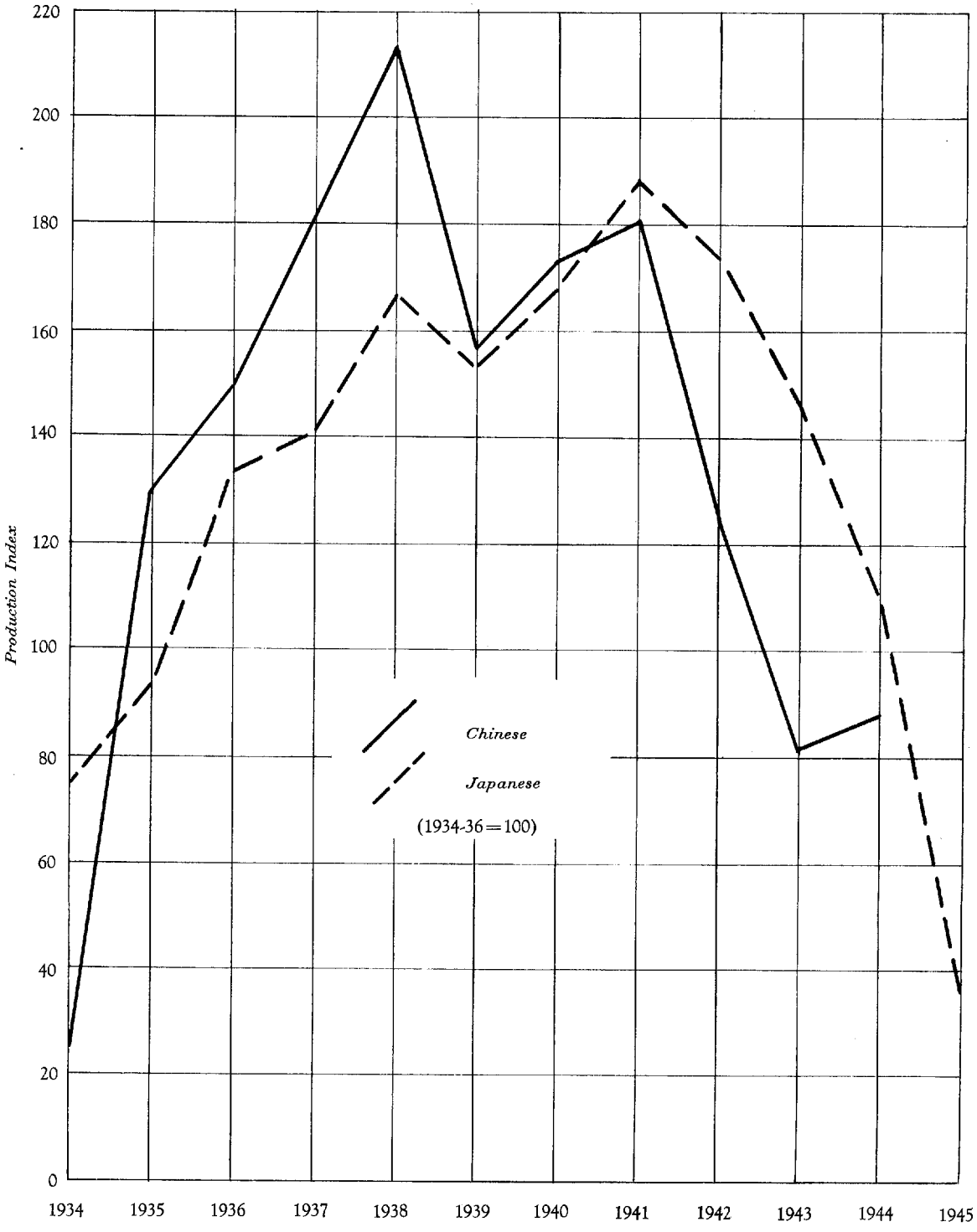
c. At the beginning of World War II period, ammonium sulfate and explosives production began expanding, but as increasing amounts of nitric acid were required for wartime explosives production, ammonium sulfate and dyestuffs production began falling off.

* Figure 9 follows p. 42.

Figure 8

COMMUNIST CHINA

AMMONIUM SULFATE PRODUCTION INDEXES



Approved For Release 1999/09/26 : CIA-RDP79-01093A000600030001-9

Figure 9

COMMUNIST CHINA

JAPANESE PRODUCTION INDEXES

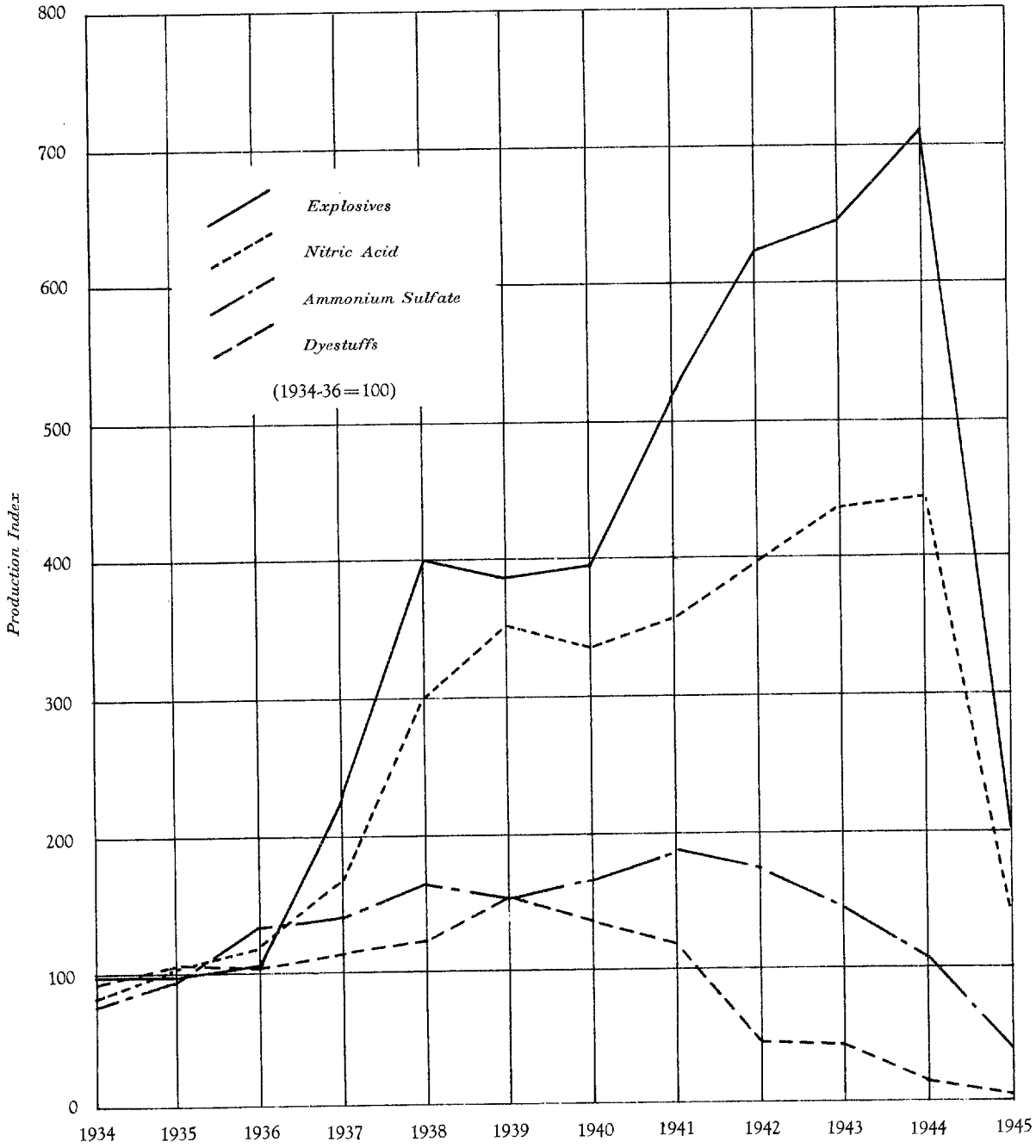


Table 11

Indexes of Japanese Production of Dyestuffs, Nitric Acid, and Explosives 1934-45

1934-36 = 100 55/

Year	Dyestuffs	Nitric Acid	Explosives
1934	92.3	79.1	95.9
1935	104.5	100.3	95.9
1936	103.1	120.6	108.3
1937	115.5	168.2	230.3
1938	123.8	299.9	405.6
1939	155.4	351.6	388.8
1940	134.0	335.2	396.0
1941	117.8	358.2	520.5
1942	47.7	397.0	624.7
1943	42.3	438.9	647.4
1944	16.8	445.3	715.4
1945	3.5	128.3	195.9

4. Finally, when the Japanese collapse came in 1945, all production fell rapidly.

The above relationships are believed to be directly analogous to the Chinese situation during the 10 years preceding 1945.

2. Method Used in Calculating Chinese Indexes of Ammonium Sulfate Production.

Ammonium sulfate production figures appearing in Table 1* for the years 1934-36 total 365,200 tons. The annual average for these three years is 121,733 tons. Using this 3-year average as the denominator, indexes of ammonium sulfate production are calculated by dividing ammonium sulfate production for the years 1934-44 by 121,733, and appear in Table 10.**

* P. 5, above.
** P. 42, above.

3. Method Used in Calculating Fixed Nitrogen (N) Content of Nitrogen Products, or Vice Versa.

Conversions appearing in Tables 2,* 4,** and 8*** are calculated on the basis of the following stoichiometric relationships:

Product	Molecular Weight	(N) Content	Percent (N)
Ammonium sulfate	132	28	21.2
Nitric acid	63	14	22.2
Ammonium nitrate	80	28 (total)	35.0
		14 (ammonium portion)	17.5

4. Methods Used in Obtaining Chinese Fixed Nitrogen Capacity.

Capacity figures appearing in Table 3**** are summations based on capacity estimates for the years indicated as they appear for individual plants in Appendix B. These capacity estimates are based on the analyst's technical interpretations of information regarding capacity variations for individual plants.

5. Method Used in Estimating Maximum Operable Capacity for Production of Nitric Acid and Ammonium Nitrate at Synthetic Ammonia Plants.

Total capacity for nitric acid production at synthetic ammonia plants (Plants 1 to 3 in Appendix B) amounts to 57 tons per day. The annual production estimate is 20,100 tons, based on 350 days operation. Using a similar calculation, ammonium nitrate production appears as 11,400 tons, based on a daily capacity of 32.5 tons in the three synthetic ammonia plants.

6. Methods Used in Calculating Net International Trade in Ammonium Sulfate.

Because of the political division existing up until unification of the present geographical area of Communist China, net international

* P. 8, above.
** P. 11, above.
*** P. 17, above.
**** P. 9, above.

trade calculations had to be based on Chinese and Manchurian imports and exports of ammonium sulfate for the years 1928-44. The net trade was then converted to nitrogen, in order to facilitate a nitrogen balance.

Complete data were not available for the years covered. Estimates made by the analyst to supplement available data include: (1) no Manchurian exports during 1928-1931, (2) no Chinese exports during 1933-1939, (3) 101,500 tons exported from Manchuria in 1941 and 1942, and (4) no international trade during 1944.

7. Methods Used in Calculating Material Requirements in Production of Ammonium Sulfate at Selected Chinese Plants.

The amounts of ammonium sulfate production shown for the selected plants in Table 7* are calculated from the estimated 1953 fixed nitrogen capacities given in Appendix B.

Iron pyrites required in the production of sulfuric acid at the An-shan and Fu-shun plants are estimated at 35 percent sulfur content, and are calculated to furnish theoretical amounts of sulfur for production of sulfuric acid sufficient for the estimated ammonium sulfate production. Coal required for byproduct nitrogen production at An-shan is calculated on the basis of 0.244 percent nitrogen yield per ton.

Oil shale required for byproduct nitrogen production at Fu-shun is calculated on the basis of 1.0 percent ammonium sulfate yield per ton.

Input items required for production of ammonium sulfate at the Liu-ho synthetic ammonia plant are calculated on the basis of factors given in a 1948 Yungli Pre-Project Report.

8. Methods Used in Estimating Synthetic Ammonia Capacity for 1954 and 1955.

In V, above, 1954 synthetic ammonia production is estimated as 37,000 tons. This estimate is based on an increase of 20 tons per day of ammonia over 1953 estimated daily capacity at the Dairen

* P. 16, above.

Works. Capacities at the Yungli and Shanghai plants are unchanged. The calculation is: 129 tons of ammonia times 350 operating days; converting this product to a nitrogen basis yields 37,000 tons (N).

In calculating the 1955 estimated synthetic ammonia capacity, a method similar to the above is used. To an estimated 129 tons of ammonia capacity per day for 1954 is added 30 tons in consideration of estimated production at Wu-t'ung-ch'iao for 1955. This gives a capacity of 46,000 tons (N) for 1955.

9. Methods Used in Estimating Byproduct Nitrogen Capacities for 1954 and 1955.

The predicted increase of 4,200 tons of byproduct nitrogen capacity in 1954 over estimated 1953 capacity is based on estimates of new construction at An-shan, Chi-lin, and Kan-ching-tzu. The increase predicted for 1955 is 8,300 tons of byproduct nitrogen over 1954 capacity, based on estimated completion of additional facilities at Fu-shun and An-shan.

APPENDIX D

GAPS IN INTELLIGENCE

A study of the information available has allowed the formation of some broad conclusions regarding the strategic importance and vulnerability of the Chinese fixed nitrogen industry. If more information were available on the state of the industry since the Communist seizure, a more precise account of fixed nitrogen capabilities could be drawn.

Apart from data presented on ammonium sulfate fertilizer production and consumption, more complete information on the other products of the fixed nitrogen industry would provide a greater insight into Chinese intentions and capabilities. Such information would show the industrial and military requirements and consumption of fixed nitrogen, and demonstrate more clearly the strategic implications of the fixed nitrogen industry.

APPENDIX E

SOURCES

Evaluations, following the classification entry and designated "Eval.," have the following significance:

Source of Information	Information
Doc. - Documentary	1 - Confirmed by other sources
A - Completely reliable	2 - Probably true
B - Usually reliable	3 - Possibly true
C - Fairly reliable	4 - Doubtful
D - Not usually reliable	5 - Probably false
E - Not reliable	6 - Cannot be judged
F - Cannot be judged	

"Documentary" refers to original documents of foreign governments and organizations; copies or translations of such documents by a staff officer; or information extracted from such documents by a staff officer, all of which may carry the field evaluation "Documentary."

Evaluations not otherwise designated are those appearing on the cited document; those designated "RR" are by the author of this report. No "RR" evaluation is given when the author agrees with the evaluation on the cited document.

25X1A2g 1. [redacted]

2. Report on Japanese Assets in Manchuria, Jul 1946. U. Eval. RR 1.

3. The Economic Vulnerability of Japan: Ammonium Sulfate, Prepared for the Office of the Administrator of Export Control, 7 Apr 1941. C. Eval. RR F-2.

25X1X7 [redacted]

The Manchukuo Yearbook, 1931. U. Eval. RR B-2.
Far East Yearbook, 1941. U. Eval. RR B-2.
The Orient Economist, Tokyo, 1940. U. Eval. RR F-2.
Report on Japanese Assets in Manchuria, op. cit.
JANIS, No. 74, Chapter IX, Feb 1946. C. Eval. RR A-2.
Yungli Pre-Project Report, 1948. U. Eval. RR B-2.
CIA, FDD U-3789, Report No. 257779, Research Section, South Manchurian Railroad Company, 20 Jan 1943. C. Eval. RR B-3.
State, American Consulate General, Hong Kong, Press Translation, No. 262, 1 Oct 1953. U. Eval. RR F-2.

4. Report on Japanese Assets in Manchuria, op. cit.

25X1A2g [redacted]

CIA, FDD, Report No. U-3027, 12 Mar 1953. C. Eval. RR B-3.
China Mission Data Report, 330.951, A 58108C, Sep 1944. C. Eval. RR B-3.

25X1A2g [redacted]

25X1X7 [redacted]

STATSPEC [redacted]

25X1A2g [redacted]

The Manchukuo Yearbook, 1942. U. Eval. RR B-2.

5. [redacted] 25X1A

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25X1X7 6. [redacted]

25X1A2g [redacted]

Yungli Pre-Project Report, op. cit.

7. China Trade Monthly, "Ammonium Sulfate Trade in China," Shanghai, Jun 1947, p. 38. U. Eval. RR C-2.
China Trade Monthly, op. cit., "Consumption of Chemical Fertilizers in China." U. Eval. RR C-2.
China Trade Monthly, op. cit., "Net Value and Quantities of China's Principal Imports, 1926-1947." U. Eval. RR C-2.
China Trade Monthly, op. cit., Sep 1948, "Prewar Imports of Chemical Fertilizer." U. Eval. RR C-2.

25X1A [redacted]

Survey of Industrial Development in Manchukuo Since 1931, prepared for the Projects Section Economic Defence Board, Bureau of Foreign and Domestic Commerce, 1 Dec 1941. U. Eval. RR B-2.
CIA, FDD 233499, Annual Returns of Foreign Trade of Manchuria, 1951. C. Eval. RR B-2.
Foreign Minerals Survey, "Mineral Resources of China," Jan 1948, Vol. 2, No. 7, p. 161. U. Eval. RR B-1.

25X1A2g [redacted]

Hong Kong Trade Returns, Department of Commerce and Industry, Hong Kong, Dec 1952. U. Eval. RR A-1.
Hong Kong Trade Returns, op. cit., Exports, Oct 1953. U. Eval. RR A-1.

25X1X7 8. [redacted]

STATSPEC 9. [redacted]

25X1A2g 10. [redacted]

11. [redacted]

STATSPEC 12. [redacted]

13. Ibid.

25X1X7 14. [redacted]

25X1A2g 15. [redacted]

16.

17.

25X1X7 18. [redacted]

19. The Washington Star, 25 Jan 1953. U. Eval. RR B-2.

20. The New York Times, 20 Dec 1953. U. Eval. RR B-1.

25X1A2g [redacted]

21. The Washington Star, 26 Mar 1953. U. Eval. RR B-2.
The New York Times, 27 Jul 1953. U. Eval. RR B-1.
The New York Times, 28 Jul 1953. U. Eval. RR B-1.

22. The Washington Star, 13 Jul 1953. U. Eval. RR B-2. 25X1A

[redacted]

23. China Trade Monthly, "Ammonium Sulfate Trade in China," Shanghai, Jun 1947, p. 38. U. Eval. RR C-2.
China Trade Monthly, op. cit., "Consumption of Chemical Fertilizers in China." U. Eval. RR C-2.
China Trade Monthly, op. cit., "Net Value and Quantities of China's Principal Imports, 1946-1947." U. Eval. RR C-2.
China Trade Monthly, op. cit., Sep 1948, "Prewar Imports of Chemical Fertilizer. U. Eval. RR C-2.

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Survey of Industrial Development in Manchukuo Since 1931, prepared for the Projects Section Economic Defence Board, Bureau of Foreign and Domestic Commerce, 1 Dec 1941. U. Eval. RR B-2.
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Hong Kong Trade Returns, Department of Commerce and Industry, Hong Kong, Dec 1952. U. Eval. RR A-1.
Hong Kong Trade Returns, op. cit., Exports, Oct 1953. U. Eval. RR A-1.

25X1A2g 24. [redacted]
25X1X7

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Yungli Pre-Project Report, op. cit.
CIA, FDD Report No. U-3032, op. cit.

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STATSPEC

26. CIA, FDD, Report No. U-3027, op. cit.

27. [redacted]
25X1A2g

Report on Japanese Assets in Manchuria, op. cit., Chapter IX.

28. Ibid.

STATSPEC [redacted]
29.

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Hsin Weh Jih Pao, Shanghai, 4 Nov 1952. U. Eval. RR C-2.

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39. Third World Power Conference, op. cit.

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40. CIA, FDB 328781, 1937. S. Eval. RR C-2.

25X1A2g [redacted]

41. Report on Japanese Assets in Manchuria, op. cit., Appendix 10, Plant Inspection Report, 8-C-2.

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43. China Mission Data Report, 330.951, AS 8108C, Sep 1944. C. Eval. RR B-3.

44. Ibid.

25X1A2g [redacted]
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46.

47. Report on Japanese Assets in Manchuria, op. cit., Appendix 10.

48. [redacted]

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